AMENDMENT OF THE CLAIMS:

Claim 9 amended:

9. An enhanced volume phase grating comprising:

a rigid support means;

a volume phase medium attached to said rigid support means;

a transparent cover means attached to said volume phase medium with a transparent adhesive to provide a sealant and protectant for said volume phase medium;

the bulk refractive index, n, of said volume phase medium being periodically modulated within the thickness, T, of said volume phase medium in a direction parallel to the surface of said volume phase medium, with a peak value of refractive index equal to $n+\Delta n$, where Δn is the peak modulation of said bulk refractive index, n, the periodic sequence of said peak values of said bulk refractive index throughout said thickness, T, of said volume phase medium creating a periodic structure of Bragg surfaces within said volume phase medium with a period, d, where

said period, d, is established by selecting any two positive integers s and p, such that s > p, and any arbitrary external angle of incidence, θ_i, calculating the internal angle of diffraction, β, with the following equation:

$$\beta = \text{either } a\cos\left(\frac{2p-1}{2s-1}\right)-\alpha \text{ or } 180-a\cos\left(\frac{2p-1}{2s-1}\right)-\alpha,$$

where:

$$\alpha = a\sin\left(\frac{\sin\theta_i}{n}\right)$$

and using the following equation:

$$d=\frac{\lambda}{n(\sin\alpha+\sin\beta)},$$

where λ is the nominal free-space wavelength for which said enhanced volume phase grating is designed,

~~$\alpha + \beta = 2\theta$ and~~

~~$2\theta =$ either $a\cos\left(\frac{2p-1}{2s-1}\right)$ degrees or $180 - a\cos\left(\frac{2p-1}{2s-1}\right)$ degrees,~~

~~where s and p are integers and $s > p > 0$,~~

and said peak modulation, Δn, of said bulk refractive index is obtained from the following equation:

$$\Delta n = \frac{\lambda}{T}\left(\frac{2s-1}{2}\right)\sqrt{(\cos\alpha)\left(\cos\alpha - \frac{\lambda}{nd}\tan\left(\frac{\beta-\alpha}{2}\right)\right)}\,.$$

~~$$\Delta n = \frac{\lambda}{T}\left(\frac{2s-1}{2}\right)\sqrt{C_R C_S}\,,$$~~

~~where $C_R = \cos\alpha$ and $C_S = \cos\alpha - \frac{\lambda}{nd}\tan\left(\frac{\beta-\alpha}{2}\right)$;~~

values of said bulk refractive index, n, and said peak modulation, Δn, being established using well known exposure and processing procedures for said volume phase medium;

whereby the S-polarization diffraction efficiency and the P-polarization diffraction efficiency of said enhanced volume phase grating, when illuminated by an incident beam of said nominal free-space wavelength, λ, at ~~an~~ said ~~internal~~ external angle of incidence, θ_i, are simultaneously maximized at a common value of the product ΔnT, thereby simultaneously minimizing insertion loss and PDL in a highly dispersive volume phase grating.

Claim 12 amended:

12. The enhanced volume phase grating of claim 9 wherein said rigid support means is a transparent medium ~~, such as glass or fused silica,~~ and said transparent cover means is a similar or identical transparent medium.

Claim 15 amended:

15. The enhanced volume phase grating of claim 12 wherein the external surfaces of said transparent medium and said transparent cover means are coated with an anti-

reflection coating such that the overall loss for the S-polarized light is somewhat greater than the overall loss for the P-polarized light at said nominal free-space wavelength, thereby minimizing the ~~worst case~~ maximum PDL.

Claim 16 amended:

16. The enhanced volume phase grating of claim 12 wherein the external surfaces of said transparent medium and said transparent cover means are coated with an anti-reflection coating such that the overall loss for the S-polarized light is somewhat greater than the overall loss for the P-polarized light after two passes through said enhanced volume phase grating at said nominal free-space wavelength, thereby minimizing the ~~worst case~~ maximum PDL in a two-pass design.

Clean version of all eight claims:

9. An enhanced volume phase grating comprising:

a rigid support means;

a volume phase medium attached to said rigid support means;

a transparent cover means attached to said volume phase medium with a transparent adhesive to provide a sealant and protectant for said volume phase medium;

the bulk refractive index, n, of said volume phase medium being periodically modulated within the thickness, T, of said volume phase medium in a direction parallel to the surface of said volume phase medium, with a peak value of refractive index equal to $n+\Delta n$, where Δn is the peak modulation of said bulk refractive index, n, the periodic sequence of said peak values of said bulk refractive index throughout said thickness, T, of said volume phase medium creating a periodic structure of Bragg surfaces within said volume phase medium with a period, d, where

said period, d, is established by selecting any two positive integers s and p, such that s > p, and any arbitrary external angle of incidence, θ_i, calculating the internal angle of diffraction, β, with the following equation:

$$\beta = \text{either } a\cos\left(\frac{2p-1}{2s-1}\right)-\alpha \quad \text{or} \quad 180-a\cos\left(\frac{2p-1}{2s-1}\right)-\alpha,$$

where:

$$\alpha = a\sin(\frac{\sin\theta_i}{n})$$

and using the following equation:

$$d = \frac{\lambda}{n(\sin\alpha + \sin\beta)},$$

where λ is the nominal free-space wavelength for which said enhanced volume phase grating is designed,

and said peak modulation, Δn, of said bulk refractive index is obtained from the following equation:

$$\Delta n = \frac{\lambda}{T}(\frac{2s-1}{2})\sqrt{(\cos\alpha)(\cos\alpha - \frac{\lambda}{nd}\tan(\frac{\beta-\alpha}{2}))},$$

values of said bulk refractive index, n, and said peak modulation, Δn, being established using well known exposure and processing procedures for said volume phase medium;

whereby the S-polarization diffraction efficiency and the P-polarization diffraction efficiency of said enhanced volume phase grating, when illuminated by an incident beam of said nominal free-space wavelength, λ, at said external angle of incidence, θ_i, are simultaneously maximized at a common value of the product ΔnT, thereby simultaneously minimizing insertion loss and PDL in a highly dispersive volume phase grating.

10. The enhanced volume phase grating of claim 9 wherein said volume phase medium is dichromated gelatin.

11. The enhanced volume phase grating of claim 9 wherein said index modulation, Δn, of said volume phase medium is greater than 0.1, and preferably on the order of 0.2, thereby decreasing Bragg angle sensitivity.

12. The enhanced volume phase grating of claim 9 wherein said rigid support means is a transparent medium and said transparent cover means is a similar or identical transparent medium.